



REMARKS

In the Office Action, the Examiner rejected the claims 1-25 under 35 USC §112, 35 USC §102, and 35 USC §103. Specifically, claim 23 was rejected under 35 USC §112, claims 1-5 and 10-13 were rejected under 35 USC §102, and claims 6-9 and 14-25 under 35 USC §103. The claims have been amended to correct typographical errors and to further clarify the subject matter regarded as the invention.

Applicant also notes the finality of the restriction requirement, and that claims 26-40 have been withdrawn. Drawing corrections are also submitted herewith in response to the Examiner's objection to the drawings. In addition, the specification has been amended in response to the objection to the specification. New claim 41 has been added. Claims 1-25 and 41 are now pending. The claim rejections are fully traversed below.

Reconsideration of the application is respectfully requested based on the following remarks.

OBJECTION TO THE DRAWINGS

The Examiner has objected to the drawings. Replacement sheets for Figures 1 and 2 are submitted herewith in response to the objection. However, the Examiner has indicated that reference characters 408 and 410 are not mentioned in the description. However, Applicant notes that reference characters 408 and 410 are mentioned in the description on page 12, lines 25-27 of the specification. Accordingly, Applicant respectfully requests that the Examiner withdraw the objection to the drawings.

REJECTION OF THE CLAIMS UNDER 35 USC §112

The Examiner has indicated that there is insufficient antecedent basis for the limitation in claim 23 of "the thickness of the first layer" and "the thickness of the second layer." However,

Applicant was unable to find these limitations in claim 23. However, these limitations were first introduced in claim 22. Applicant believes this rejection was submitted in error, since there is sufficient antecedent basis for these limitations. Accordingly, Applicant respectfully requests that the Examiner withdraw the rejection to the claims under 35 USC §112.

REJECTION OF CLAIMS UNDER 35 USC §102

In the Office Action, the Examiner rejected claims 1-5 and 10-13 under 35 USC §102 as being anticipated by Fulford, Jr. et al, U.S. Patent No. 6,008,109 ('Fulford' hereinafter). This rejection is fully traversed below.

Fulford discloses a method for creating a trench isolation structure. However, the specific trench isolation structure claimed and advantages thereof are neither disclosed nor suggested by Fulford.

With respect to claim 1, the Examiner asserts that Fulford discloses "wherein the upper dielectric layer has an HF etch rate that is approximately equal to or lower than that of silicon dioxide at col. 1, lines 58-60. However, Applicant respectfully submits that col. 1, lines 58-60 merely state that "The value of this capacitance is dependent upon the lateral width of the isolation structure and the relative permittivity of the trench dielectric, which is typically silicon dioxide ("oxide")." It is important to note that the trench disclosed in the Background section of Fulford is a trench that includes a single layer rather than an upper and lower layer. Since the background section of Fulford does not disclose or suggest an upper layer and a lower layer, Applicant respectfully submits that Fulford at col. 1, lines 58-60 fails to disclose or suggest an upper layer having an HF etch rate that is approximately equal to or lower than that of silicon dioxide.

Moreover, in the detailed description of Fulford, the Examiner asserts that Fulford discloses that "the upper and lower dielectric layers together have an effective dielectric constant that is less than that of silicon dioxide." However, Applicant was unable to find reference to the effective dielectric constant in Fulford. It is important to note that the effective dielectric constant is not a sum of the dielectric constants of both the upper and lower layers. Specifically, pages 12-13 of Applicant's application recite that "[t]he intrinsic dielectric constants along with the available thickness of the materials are then used to calculate a total capacitance, from which

an equivalent dielectric constant is extracted. This may be done by accessing simulated data, using one or more equations and/or using a graph as described in Figure 4.” Accordingly, Applicant respectfully submits that claim 1 is patentable over the cited art.

Applicant believes that the independent claims and dependent claims are allowable for the reasons previously set forth. The dependent claims depend from one of the independent claims and are therefore patentable over the cited art for at least the same reasons. However, the dependent claims recite additional limitations that further distinguish them from the cited references. Hence, it is submitted that the dependent claims are patentable over the cited art. The additional limitations recited in the independent claims or the dependent claims are not further discussed as the above-discussed limitations are clearly sufficient to distinguish the claimed invention from the cited art. Thus, it is respectfully requested that the Examiner withdraw the rejection of the claims under 35 USC §102.

REJECTION OF CLAIMS UNDER 35 USC §103

In the Office Action, the Examiner rejected claims 6 and 14 under 35 USC §103 as being unpatentable over Fulford in view of Ngo et al, U.S. Patent No. 6,797,652 ('Ngo' hereinafter). This rejection is fully traversed below.

As set forth above, Fulford fails to anticipate claim 1. The dependent claims are patentable for at least those reasons set forth above. Ngo fails to cure the deficiencies of Fulford.

The claimed invention relates to a shallow trench isolation structure with low trench parasitic capacitance. Claims 6 and 14 relate to the upper layer of the trench isolation structure.

With respect to claims 6 and 14, while Fulford relates to a trench isolation structure, Ngo relates to forming capped Cu or Cu alloy interconnects. As such, there fails to be a motivation to combine the cited references. In fact, combining the cited references would result in a capped interconnect as disclosed in Ngo formed in a dielectric material in which a shallow trench isolation structure has been formed. This is emphasized by the fact that the Examiner has cited col. 3, lines 48-65, indicating that Ngo discloses “a semiconductor device that uses a low-k silicon carbide dielectric layer, formed by PECVD, having a dielectric constant of 5.0, as a capping layer.” However, it is important to note that this section of Ngo relates to treating an exposed Cu surface. Thus, this “capping layer” disclosed in Ngo is not actually an upper layer in

a trench isolation structure, but a layer above a Cu surface. Therefore, the combination of the cited references would fail to achieve the desired result (i.e., a trench isolation structure). As such, Ngo fails to cure the deficiencies of the primary reference. Therefore, Applicant respectfully submits that claims 6 and 14 are patentable over the cited references.

The Examiner rejected claims 7-9 under 35 USC §103 as being unpatentable over Fulford in view of Loboda et al, U.S. Patent No. 6,159,871 ('Loboda' hereinafter). This rejection is fully traversed below.

As set forth above, Fulford fails to anticipate claim 1. The dependent claims are patentable for at least those reasons set forth above. Loboda fails to cure the deficiencies of Fulford.

Claims 7-9 relate to the lower layer of the trench isolation structure.

Loboda relates to producing films having a low dielectric constant on a substrate. However, Loboda neither discloses nor suggests forming a lower layer in a two-layer isolation structure. Accordingly, there fails to be a motivation to combine Loboda with Fulford to use Loboda to form the lower layer of a two-layer isolation structure such as that disclosed in Fulford in the manner claimed. In fact, since Loboda discloses a single film having a low dielectric constant, it would seemingly be unnecessary to add an additional layer to the film of Loboda. Moreover, there is no teaching in Loboda of the use of such a film in a two-layer isolation structure. Since Loboda teaches a single film, Loboda teaches away from the use of a thin film as disclosed in Loboda in a two-layer isolation structure. Accordingly, Applicant respectfully submits that claims 7-9 are patentable over the cited art.

The Examiner rejected claims 15-25 under 35 USC §103 as being unpatentable over Fulford in view of Wolf. This rejection is fully traversed below.

As set forth above, Fulford fails to anticipate claim 1. The dependent claims are patentable for at least those reasons set forth above. Wolf fails to cure the deficiencies of Fulford.

The Examiner notes the deficiencies of Fulford, listing many of the limitations of the rejected claims. The Examiner seeks to cure the deficiencies of Fulford with Wolf.

The Examiner cites Wolf for conventional wet etching techniques, as well as selection of thickness of films that are well known in the art of semiconductor manufacturing. The Examiner

suggests that the specific manner in which the thicknesses of the layers in the isolation structure and manners of forming the isolation structure are obvious. For instance, with respect to claim 17, the Examiner indicates that the HF etch selectivity of the upper dielectric layer being between approximately 5:1 and approximately 30:1 to SiO₂ to have been obvious. However, Applicant respectfully submits that this is impermissible hindsight, as neither of the references discloses or suggests these specific processes or embodiments (e.g., etch selectivity numerical parameters). Accordingly, Applicant respectfully submits that claims 15-25 are also patentable over the cited art.

If there are any issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number listed below.

Applicants hereby petition for an extension of time, which may be required to maintain the pendency of this case, and any required fee for such extension or any further fee required in connection with the filing of this Amendment is to be charged to Deposit Account No. 12-2252 (Order No. 01-555)

Respectfully submitted,
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